

## CLAIMS

1. A method of fabricating a light-emitting device having a light-emitting layer section configured as having a double  
5 heterostructure in which a first conductivity type cladding layer, an active layer, and a second conductivity type cladding layer, all of which being composed of  $(\text{Al}_x\text{Ga}_{1-x})_y\text{In}_{1-y}\text{P}$  (where,  $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ), are stacked in this order, and further comprising an ITO transparent electrode layer applying drive voltage for light-emission to the light-emitting layer  
10 section on at least either side of the first conductivity type cladding layer and the second conductivity type cladding layer, comprising the steps of:  
forming a GaAs layer on the light-emitting layer section, forming the ITO transparent electrode layer so as to contact with the GaAs layer; and annealing the stack so as to allow In to diffuse from the ITO  
15 transparent electrode layer into the GaAs layer to thereby convert it into a contact layer composed of In-containing GaAs.
2. The method of fabricating a light-emitting device as claimed in Claim 1, wherein the annealing is carried out at 600°C to 750°C, both  
20 ends inclusive.
3. The method of fabricating a light-emitting device as claimed in Claim 1 or 2, wherein the annealing is carried out so as to adjust a mean In concentration of the contact layer within a range from 0.1 to 0.6  
25 on the basis of atomic ratio of In to the total concentration of In and Ga.

4. The method of fabricating a light-emitting device as claimed in any one of Claims 1 to 3, wherein process time of the annealing is set to 5 seconds to 120 seconds, both ends inclusive.

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5. The method of fabricating a light-emitting device as claimed in any one of Claims 1 to 4, wherein the light-emitting layer section is configured using  $(\text{Al}_x\text{Ga}_{1-x})_y\text{In}_{1-y}\text{P}$  (where,  $0 \leq x \leq 1$ ,  $0.45 \leq y \leq 0.55$ ).

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6. The method of fabricating a light-emitting device as claimed in any one of Claims 1 to 5, wherein thickness of the contact layer is adjusted within a range from  $0.001 \mu\text{m}$  to  $0.02 \mu\text{m}$ , both ends inclusive.

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7. The method of fabricating a light-emitting device as claimed in any one of Claims 1 to 6, wherein the annealing is carried out so as to make an In concentration distribution in the thickness-wise direction of the contact layer continuously reduce as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction.

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8. The method of fabricating a light-emitting device as claimed in any one of Claims 1 to 7, wherein the annealing is carried out so as to adjust  $C_B/C_A$  to 0.8 or below, where  $C_A$  is In concentration at the boundary position between the contact layer and the ITO transparent electrode layer, and  $C_B$  is In concentration at the boundary position on the opposite side.

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9. The method of fabricating a light-emitting device as claimed in any one of Claims 1 to 8, further comprising a step of forming, between the contact layer and either cladding layer of the first conductivity type cladding layer and the second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer.

10. The method of fabricating a light-emitting device as claimed in Claim 9, wherein the intermediate layer is formed as containing at least any one of an AlGaAs layer, a GaInP layer and an AlGaInP layer.

11. The method of fabricating a light-emitting device as claimed in Claim 9 or 10, wherein the intermediate layer and the contact layer are formed over the entire surface of the light-emitting layer section in this order, and the ITO transparent electrode layer is formed so as to cover the entire surface of the contact layer.

12. A light-emitting device having a light-emitting layer section configured as having a double heterostructure in which a first conductivity type cladding layer, an active layer, and a second conductivity type cladding layer, all of which being composed of  $(\text{Al}_x\text{Ga}_{1-x})_y\text{In}_{1-y}\text{P}$  (where,  $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ), are stacked in this order; having an ITO transparent electrode layer applying drive voltage for

light-emission to the light-emitting layer section on at least either side of the first conductivity type cladding layer and the second conductivity type cladding layer, so as to extract light from the light-emitting layer section through the ITO transparent electrode layer; and having a contact layer composed of In-containing GaAs, formed between the light-emitting layer section and the ITO transparent electrode layer, as being in contact with the ITO transparent electrode layer,

wherein the contact layer is designed to have an In concentration distribution in the thickness-wise direction thereof continuously reducing as becoming more distant away from the ITO transparent electrode layer in the thickness-wise direction.

13. The light-emitting device as claimed in Claim 12, wherein the light-emitting layer section is configured using  $(\text{Al}_x\text{Ga}_{1-x})_y\text{In}_{1-y}\text{P}$  (where,  $0 \leq x \leq 1$ ,  $0.45 \leq y \leq 0.55$ ).

14. The light-emitting device as claimed in Claim 12 or 13, wherein thickness of the contact layer is adjusted within a range from  $0.001 \mu\text{m}$  to  $0.02 \mu\text{m}$ , both ends inclusive.

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15. The light-emitting device as claimed in any one of Claims 12 to 14, wherein a mean In concentration of the contact layer is adjusted within a range from 0.1 to 0.6 on the basis of atomic ratio of In to the total concentration of In and Ga.

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16. The light-emitting device as claimed in Claim 15, wherein the contact layer is designed to have  $C_B/C_A$  of 0.8 or below, where  $C_A$  is In concentration at the boundary position between the contact layer and the ITO transparent electrode layer, and  $C_B$  is In concentration at the  
5 boundary position on the opposite side.

17. The light-emitting device as claimed in any one of Claims 12 to 16, further comprising, between the contact layer and either cladding layer of the first conductivity type cladding layer and the  
10 second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer.

18. A light-emitting device having a light-emitting layer section  
15 composed of a compound semiconductor layer, and an ITO transparent electrode layer applying drive voltage for light-emission to the light-emitting layer section, so as to extract light from the light-emitting layer section through the ITO transparent electrode layer; and having a contact layer composed of In-containing GaAs, formed between the  
20 light-emitting layer section and the ITO transparent electrode layer, as being in contact with the ITO transparent electrode layer,

wherein the light-emitting layer section is configured as having a double heterostructure in which a first conductivity type cladding layer, an active layer, and a second conductivity type cladding layer are  
25 stacked in this order; the contact layer is formed between at least either

one of the first conductivity type cladding layer and the second conductivity type cladding layer, and the ITO transparent electrode layer; and, between the contact layer and either cladding layer of the first conductivity type cladding layer and the second conductivity type cladding layer located on the side of formation of the contact layer, an intermediate layer having an intermediate band gap energy between those of the contact layer and the cladding layer is formed.

19. The light-emitting device as claimed in Claim 17 or 18, wherein the intermediate layer is formed as containing at least any one of an AlGaAs layer, a GaInP layer and an AlGaInP layer.

20. The light-emitting device as claimed in any one of Claims 17 to 19, wherein the intermediate layer and the contact layer are formed over the entire surface of the light-emitting layer section in this order, and the ITO transparent electrode layer is formed so as to cover the entire surface of the contact layer.